

# **Low Power Applications with DDR**

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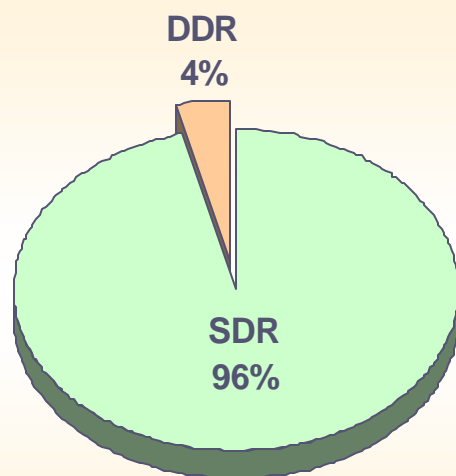
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- ✓ DDR SDRAM Power Estimation
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# Low Power Application

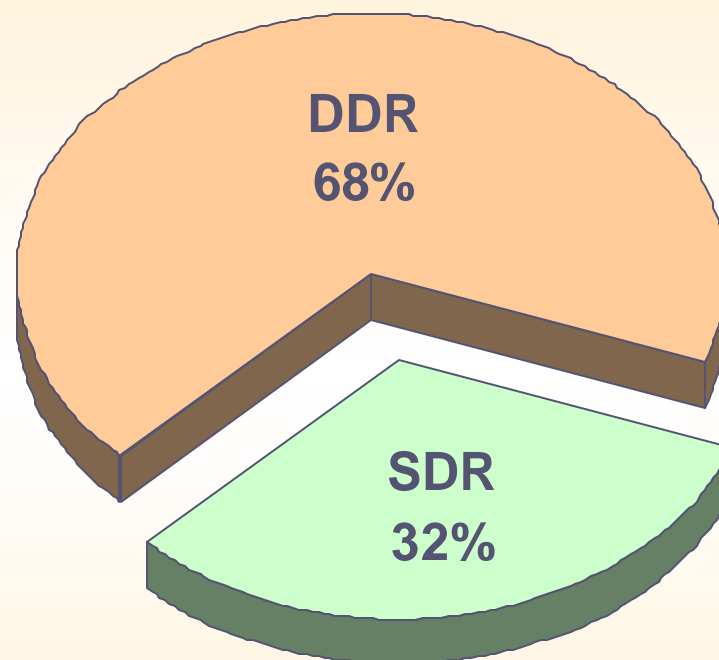
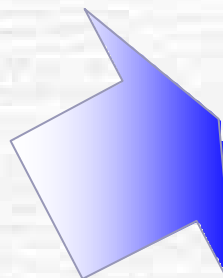


# Notebook DRAM Market Movement



2001

TAM : 550Mpcs (64M EQ)

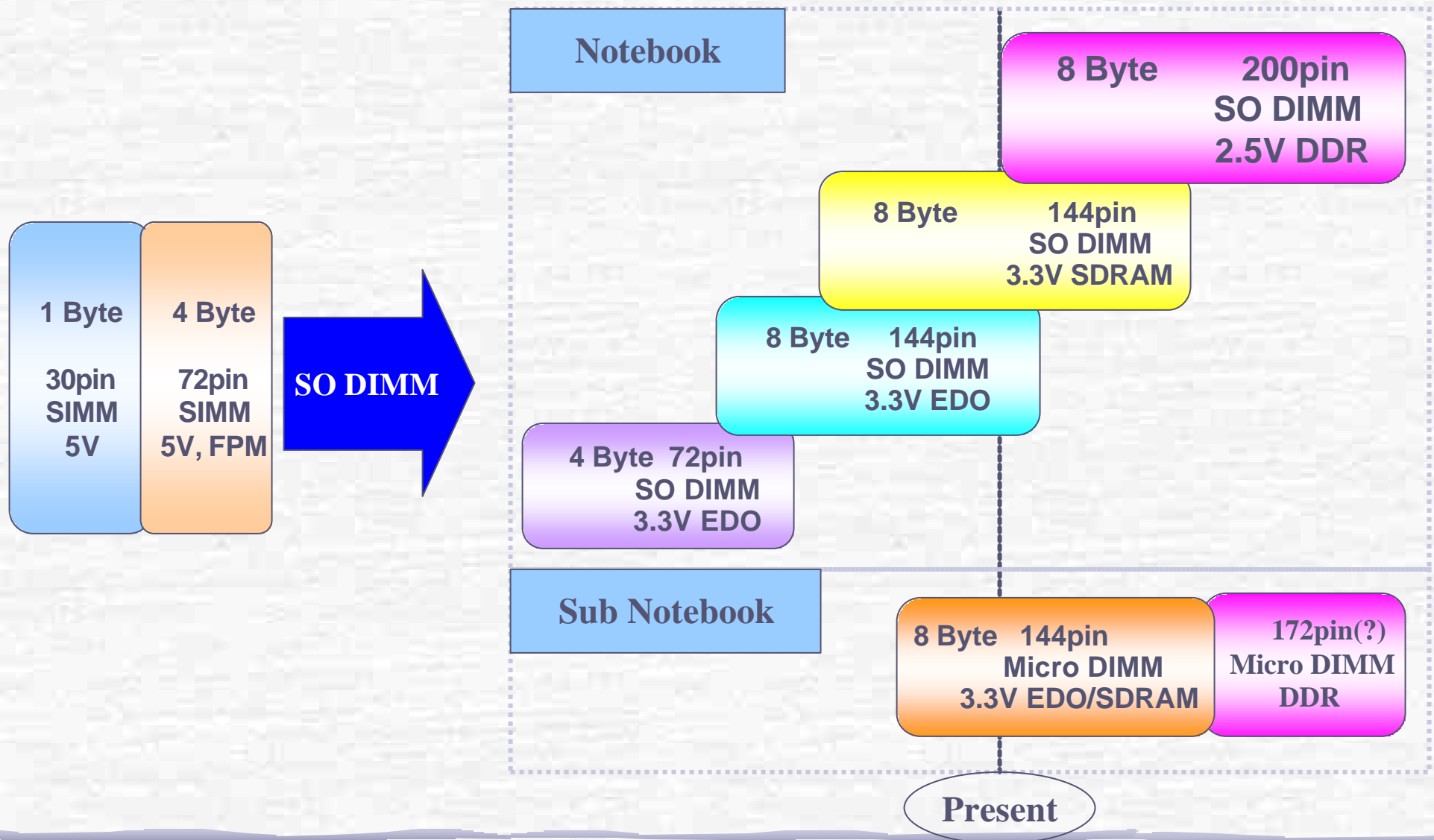


'2004

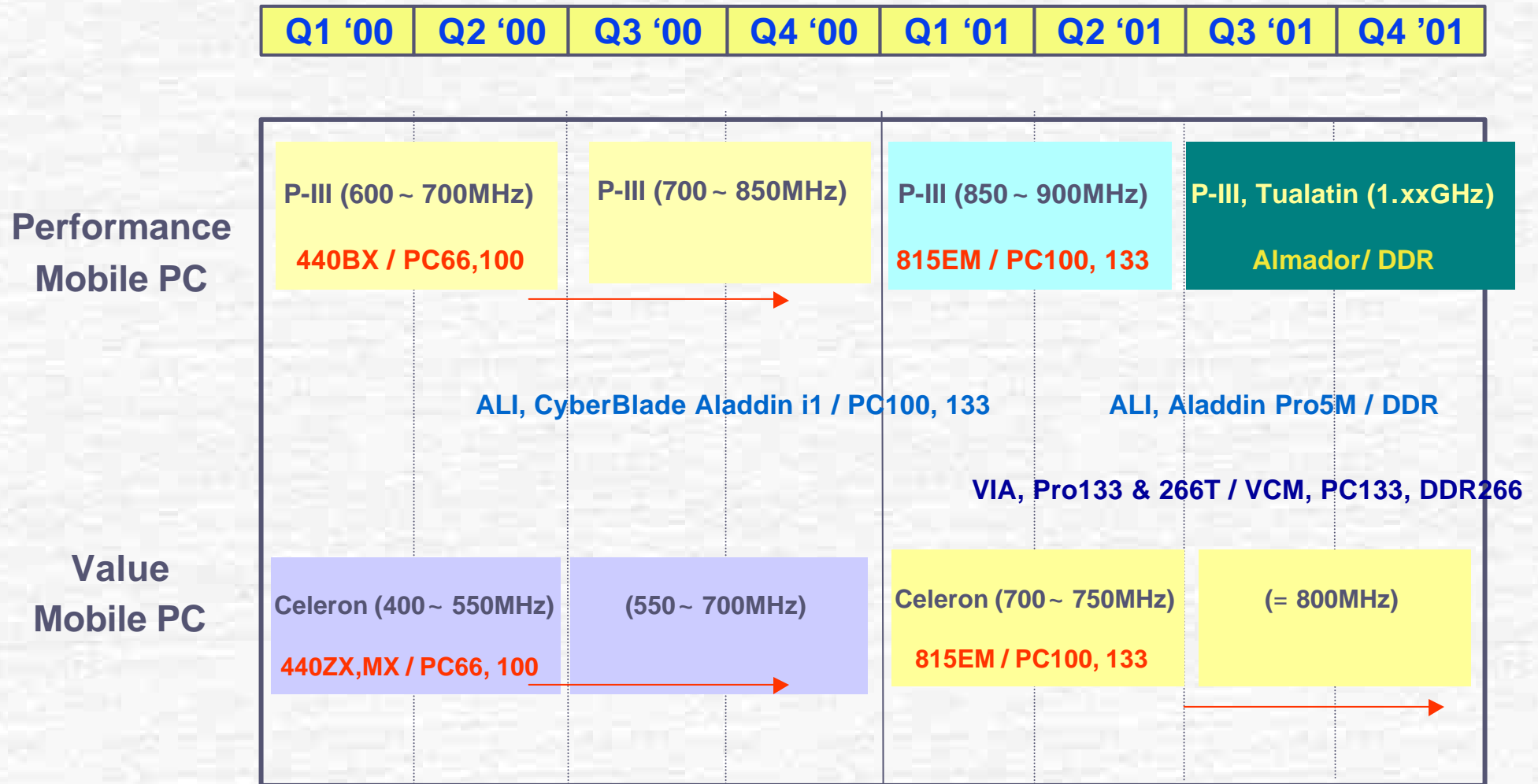
TAM : 2.0Bpcs (64M EQ)

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# Module Trend for Mobile Application



# Intel Mobile PC CPU & Chipset Trend



# Additional Mobile PC CPU & Chipset Trend

Q1 '00	Q2 '00	Q3 '00	Q4 '00	Q1 '01	Q2 '01	Q3 '01	Q4 '01
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Transmeta

TM3200 (333 ~ 400MHz)  
SDR(66 to 133MHz)

TM5400/5600 (500~ 700MHz) = 800MHz  
DDR(100 to 166MHz)  
SDR(66 to 133MHz)

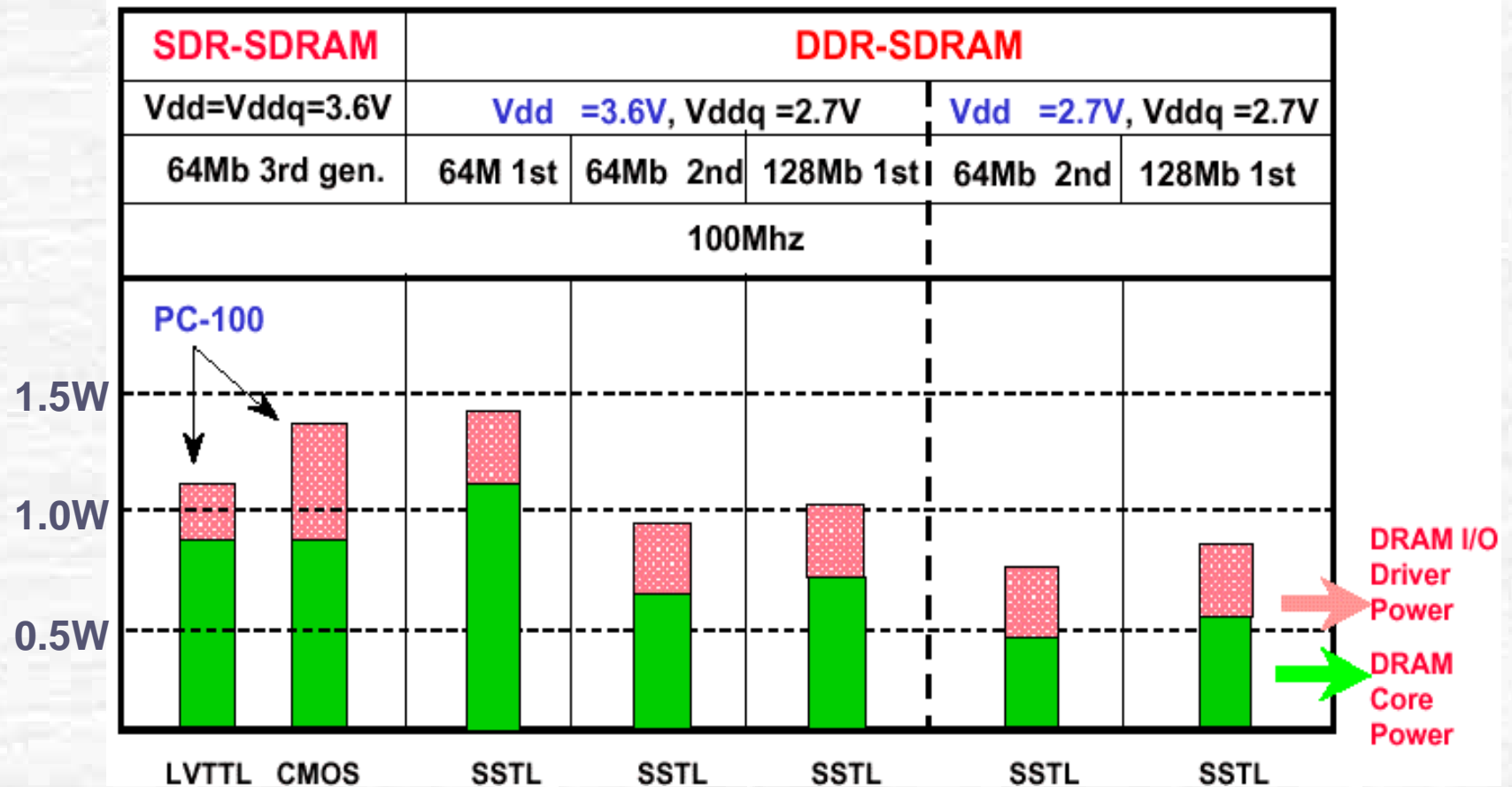
AMD

K6-2 (500 ~ 550MHz)  
ALI, CyberBlade Aladdin i1 / PC100

Duron(600~ 8xxMHz)  
VIA, KT133&266 / VCM, PC133, DDR266  
ALI, MAGIK1 / DDR

# Power Estimation of DDR SDRAM

- X16 org.
- Temp.=-5°C, 4Bank, Gapless Read Operation





# DDR/SDR Power Analysis (1)

	PC133	PC2100
Technology	SDRAM	DDR
Data Rate	133MHz	266MHz
Component Density	128Mbit	128Mbit
Vdd	3.3V	2.5V
No. of Component in System	8	8
Vterm	N/A	1.25V
Signal Voltage Swing	3.3V	0.86V

# DDR/SDR Power Analysis (2)

	PC133	PC2100
Current per device, active mode	150mA	140mA
Current per device, idle mode	20mA	20mA
Current per device, suspend mode	1mA	1mA
Time spent in active mode (%)	50	35
Time spent in idle mode (%)	20	25
Time spent in suspend mode (%)	30	40

# DDR/SDR Power Analysis (3)

	PC133	PC2100
I/O power of active control lines, pSDRAC	330 mW	190 mW
I/O power of active data lines, pDDRAC	690 mW	94 mW
AVG System I/O power, $p_{AC}=p_{SDRAC}+p_{DDRAC}$	1,020 mW	280 mW
Minimum device power = pDV_min	13 mW	20 mW
AVG system device power, pDV	730 mW	670 mW

# DDR/SDR Power Analysis (4)

PC133

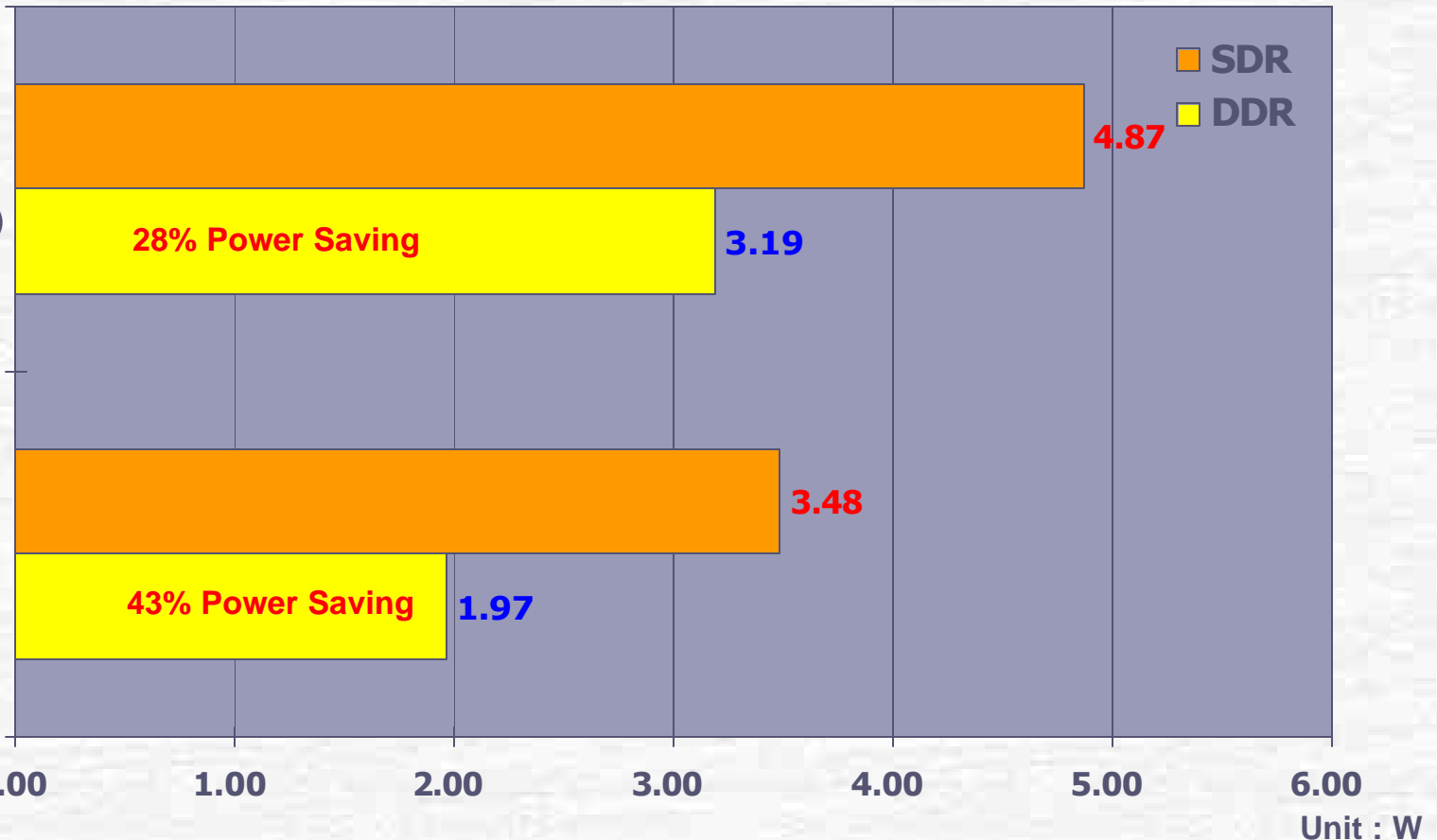
PC2100

Maximum total power $p_{\text{Max}} = p_{\text{AC}} + p_{\text{DV}}$	2,040 mW	950 mW
Minimum total power $p_{\text{Min}} = 0 + p_{\text{DV}}(\text{min})$	13 mW	20 mW
Total average power $p_{\text{Total}} = p_{\text{AC}} + p_{\text{DV}} + p_{\text{TDG}}$	2,040 mW	1,650 mW

# Memory System Power Consumption (1)

## BMEM in DOS

Two DIMMs  
(128MB + 128MB)



DDR Power Consumption include ;

- North Bridge Core Power
- Memory I/O & DIMM
- Clock Generator
- Voltage Regulator & VTT termination

SDR Power Consumption include ;

- North Bridge Core Power
- Memory I/O & DIMM
- Clock Generator

Source : ALi

# Memory System Power Consumption (2)

Winstone 99 v1.3

Two DIMMs  
(128MB + 128MB)

28% Power Saving

3.22

4.53

One DIMM  
(128MB)

42% Power Saving

2.10

3.65

SDR  
DDR

0.00

1.00

2.00

3.00

4.00

5.00

Unit : W

DDR Power Consumption include ;

- North Bridge Core Power
- Memory I/O & DIMM
- Clock Generator
- Voltage Regulator & VTT termination

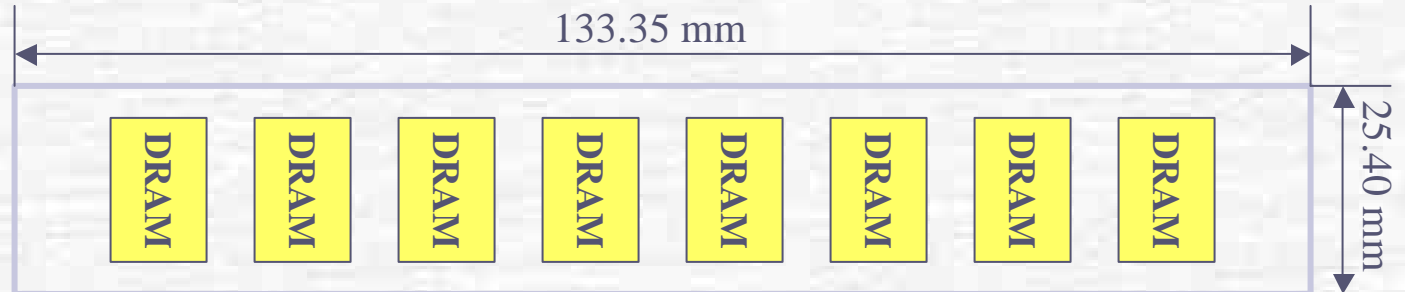
SDR Power Consumption include ;

- North Bridge Core Power
- Memory I/O & DIMM
- Clock Generator

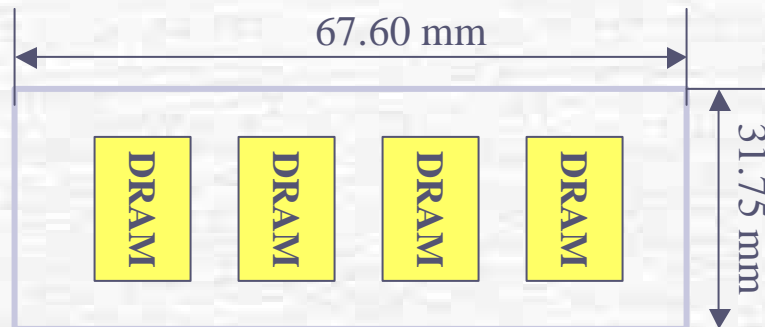
Source : ALi

# SODIMM vs. DIMM

168pin Unbuffered DIMM



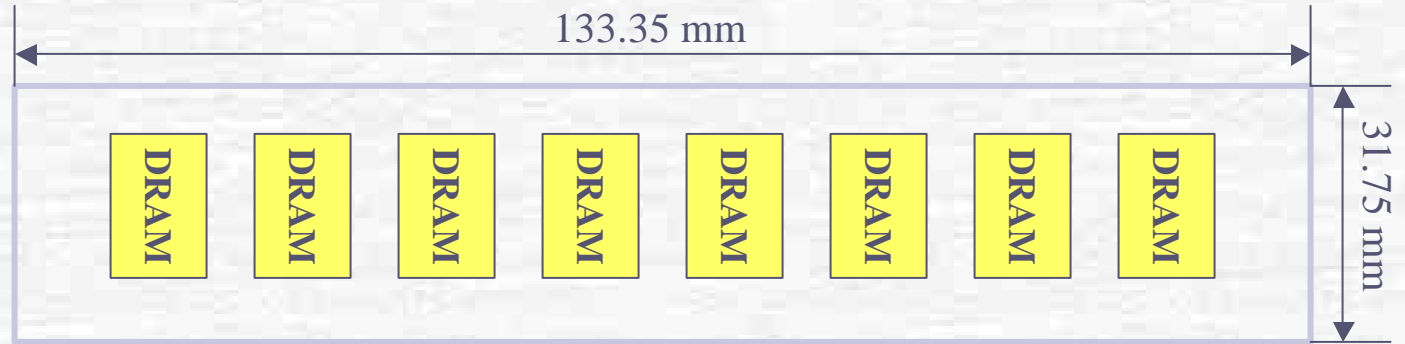
144pin SO DIMM



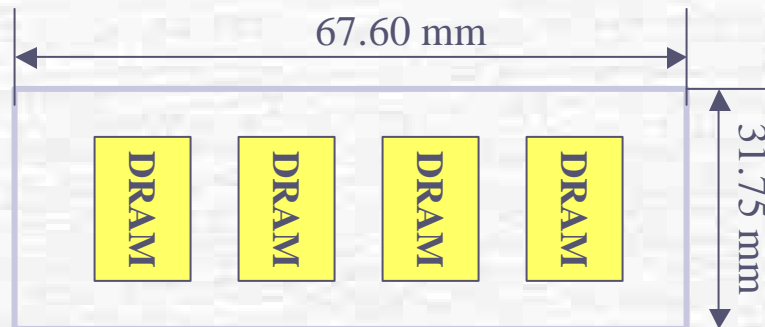
	Max No. of DRAMs w/TSOP-II	Max No. of DRAMs w/Special Package
144pin SO DIMM	8pcs	16pcs
168pin Unbuffered DIMM	16pcs	32pcs

# DDR SODIMM vs. DIMM

184pin Unbuffered DIMM



200pin SODIMM

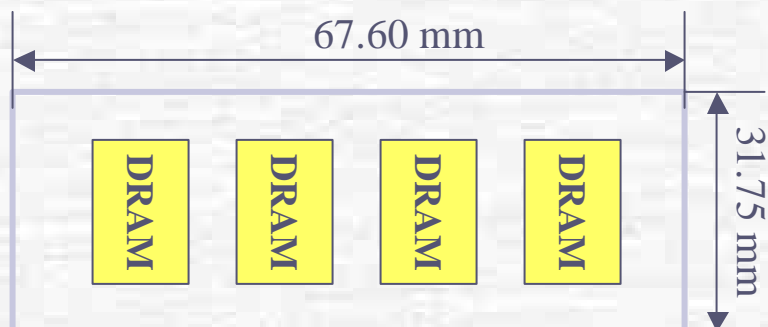


	Max No. of DRAMs w/TSOP-II	Max No. of DRAMs w/Special Package
144pin SODIMM	8pcs	16pcs
168pin Unbuffered DIMM	16pcs	32pcs

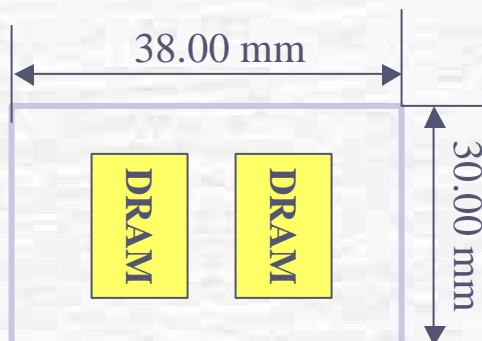


# Micro DIMM

144pin SO DIMM



Micro DIMM

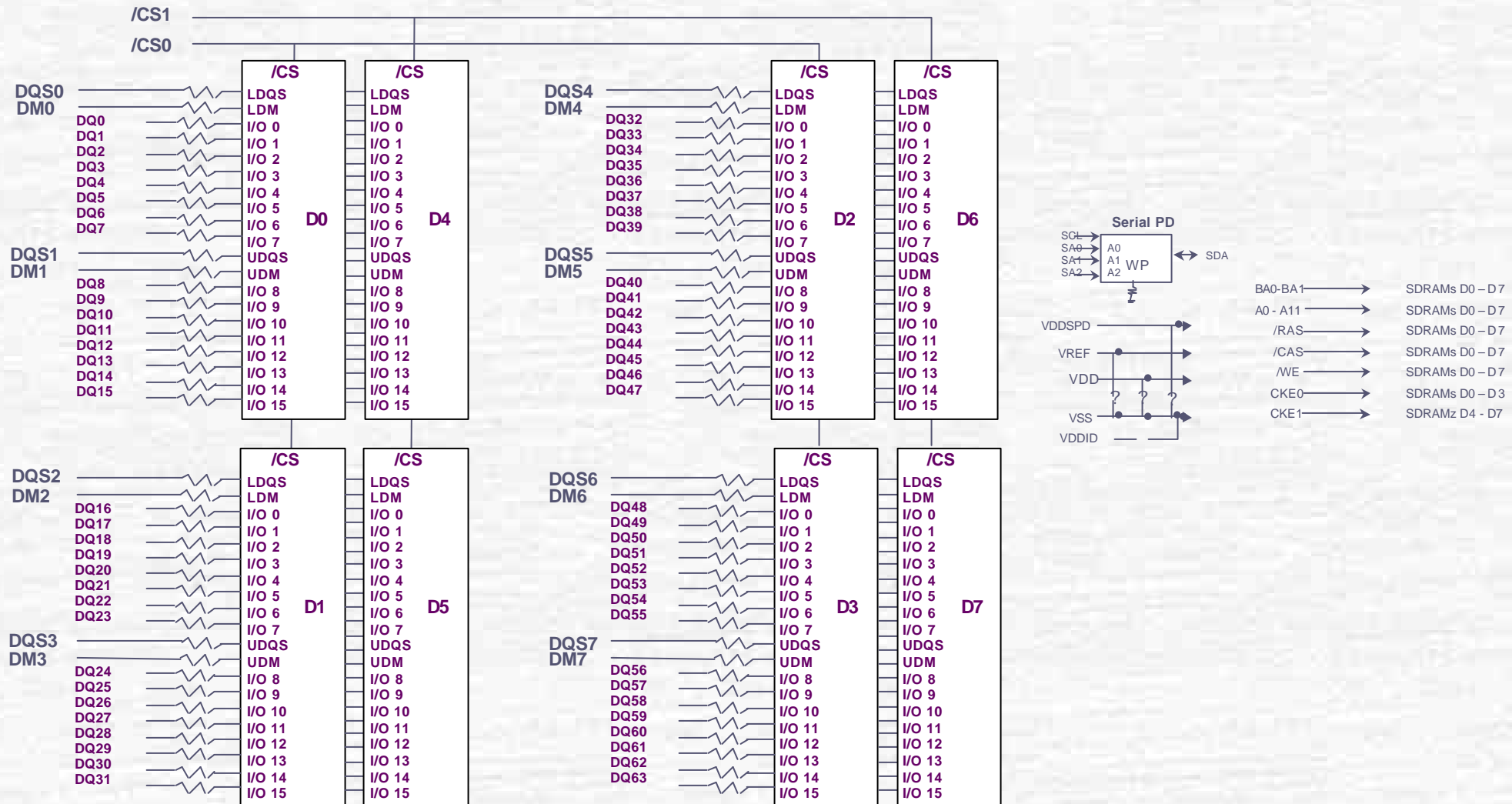


	Max No. of DRAMs w/TSOP-II	Max No. of DRAMs w/Special Package
Micro DIMM	4pcs	8pcs
144pin SO DIMM	8pcs	16pcs

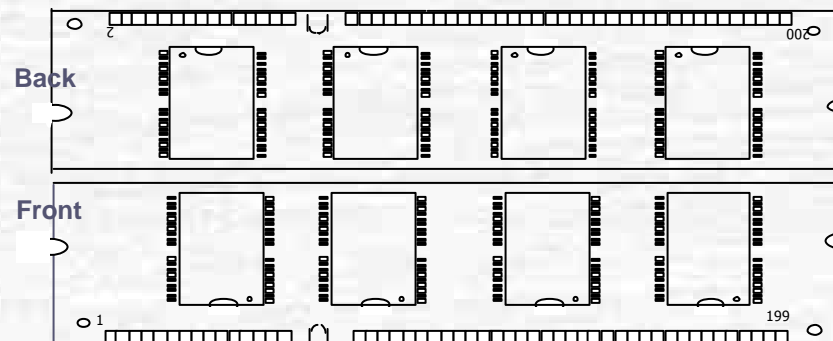
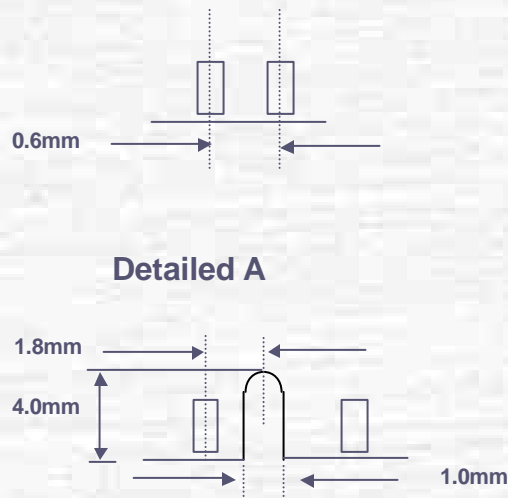
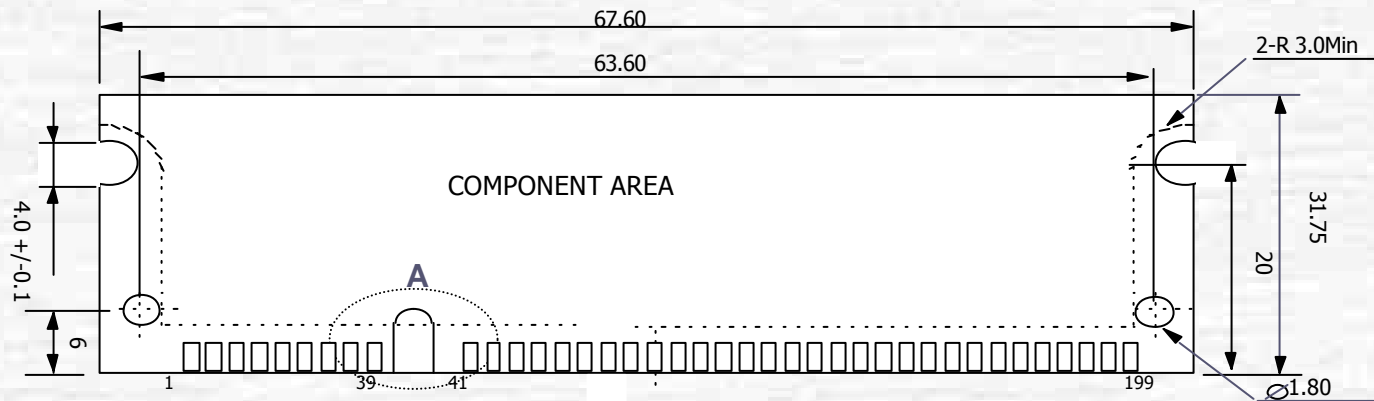
# **Advantage of using DDR for Mobile Applications**

- ✓ **Low Power**
- ✓ **High Performance**
- ✓ **Longer Battery Life**
- ✓ **JEDEC Standard Gerber**
- ✓ **Ease of Use**
- ✓ **Low Cost**

# DDR SODIMM – Block Diagram

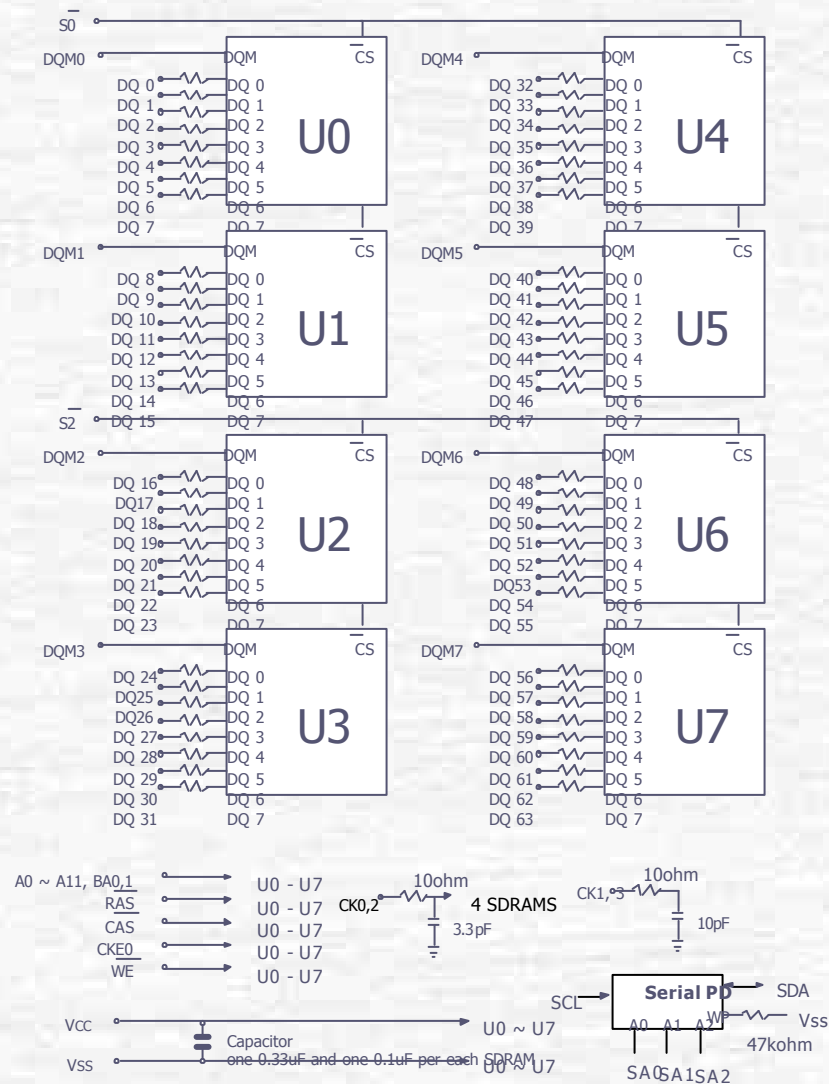


# DDR SODIMM – Package Dimension

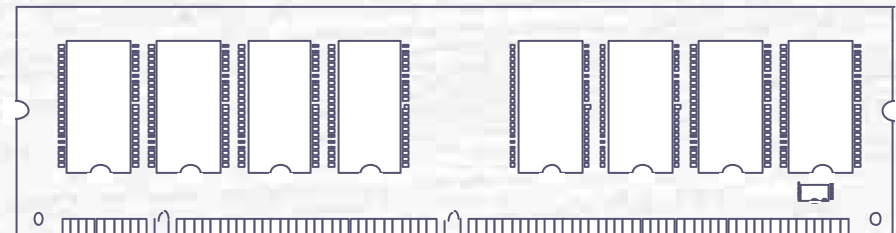
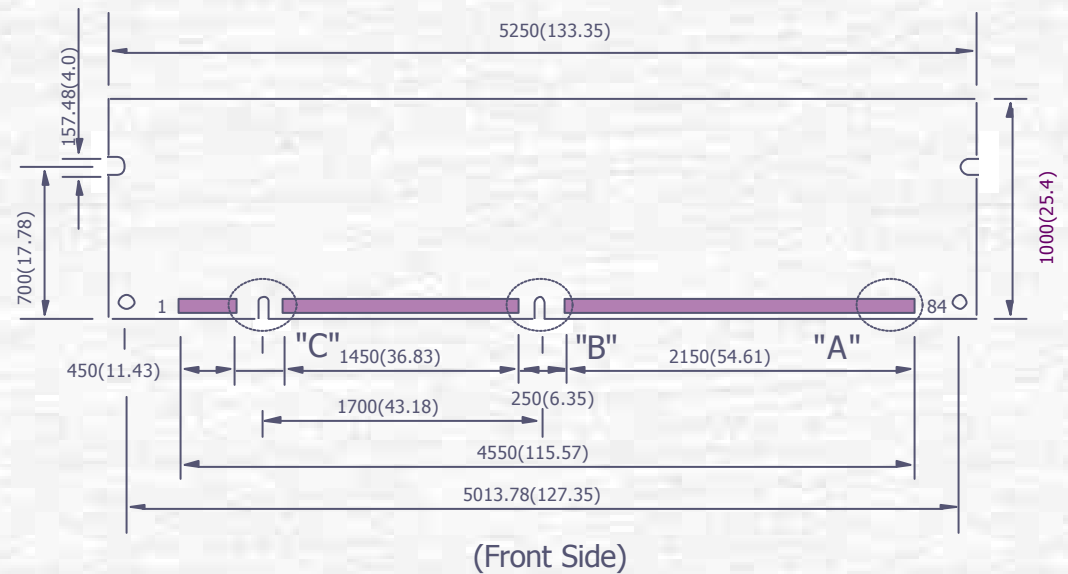


# SDR Unbuffered DIMM

## Block Diagram

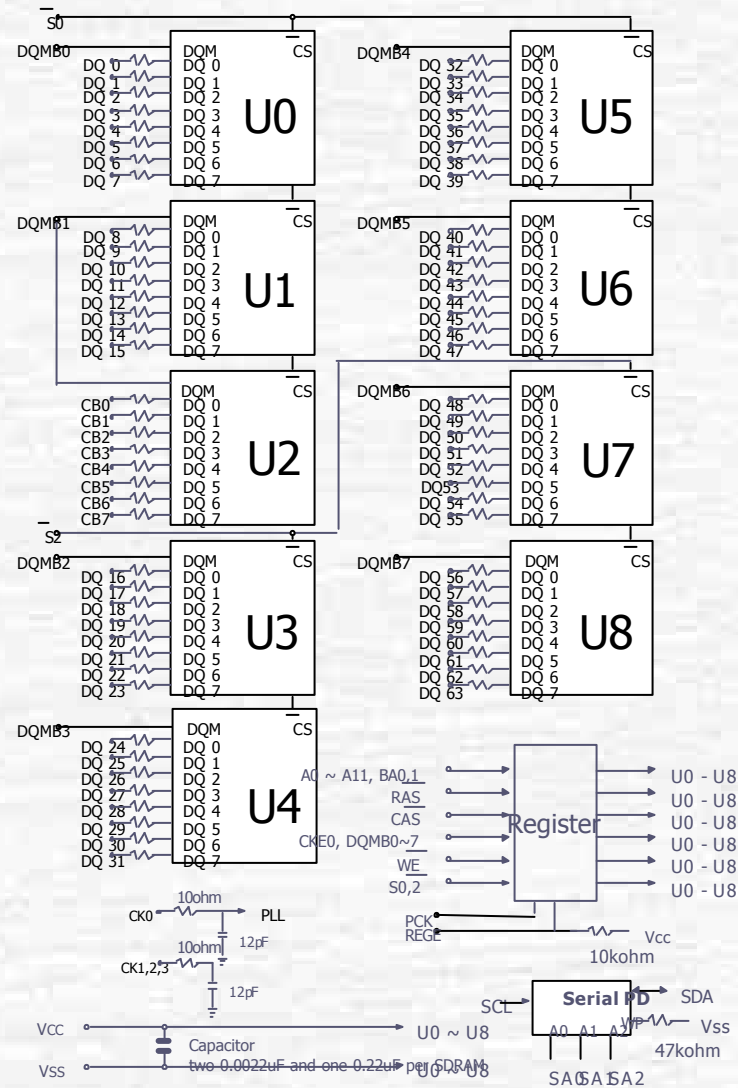


## Package Dimension

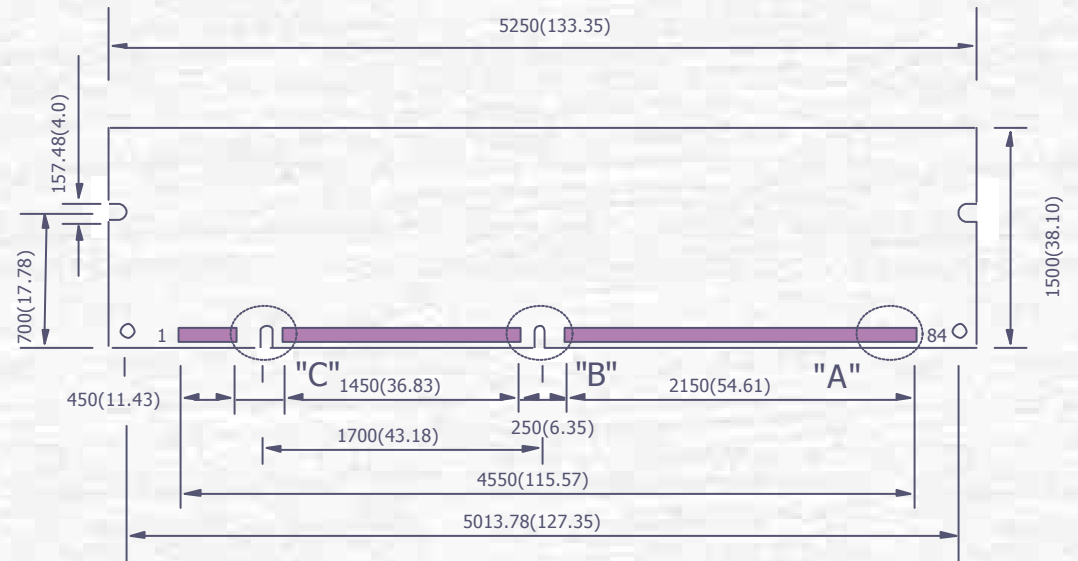


# SDR Registered DIMM

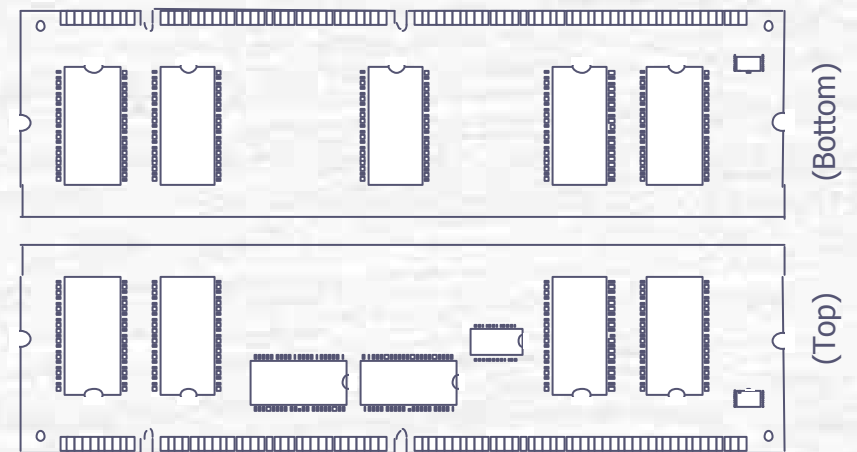
## Block Diagram



## Package Dimension



(Front Side)

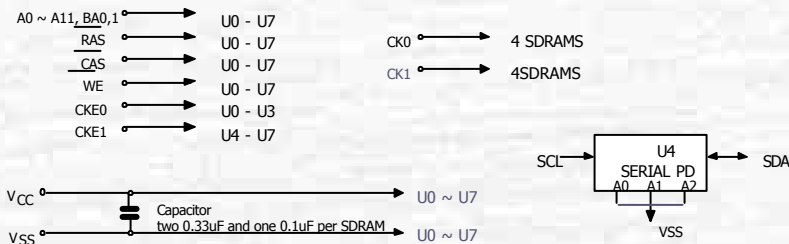
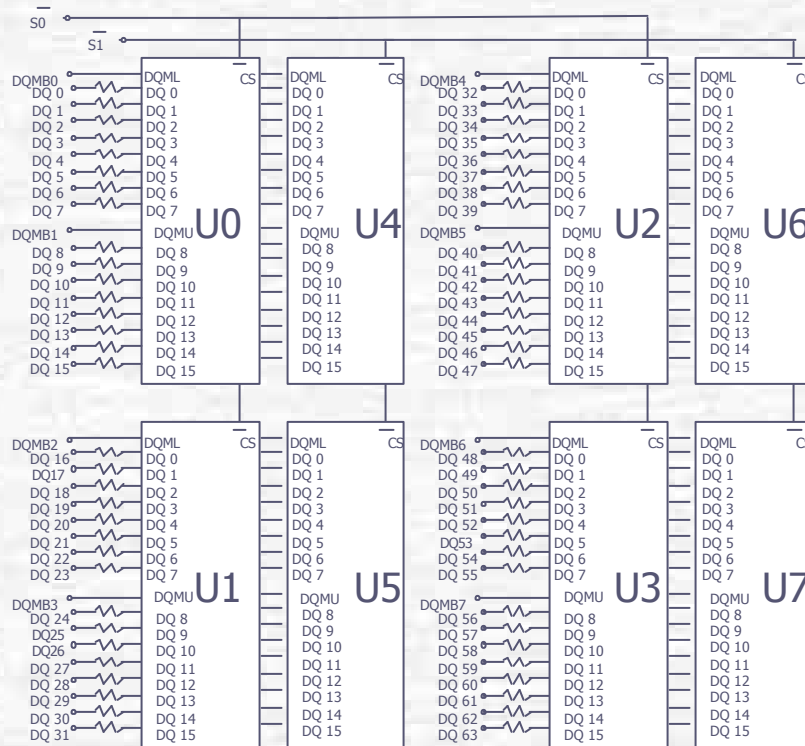


(Bottom)

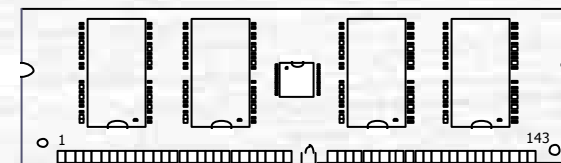
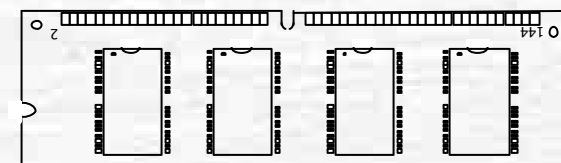
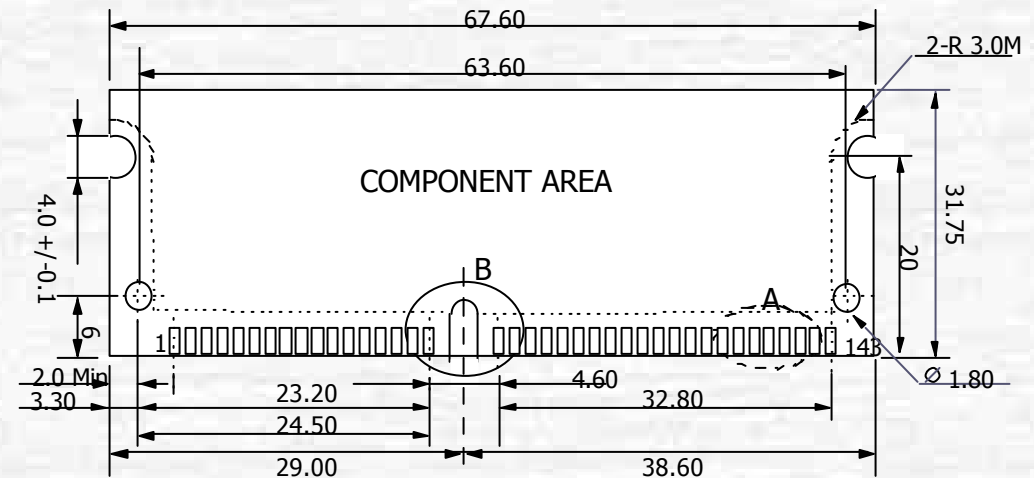
(Top)

# SDR SODIMM

## Block Diagram

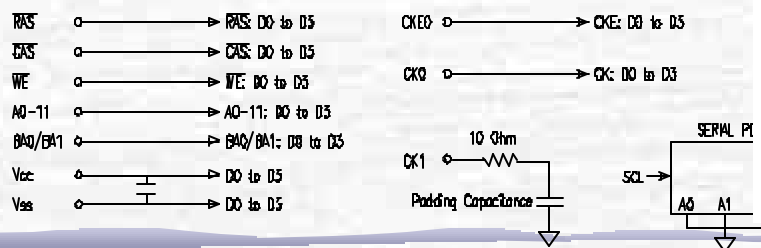
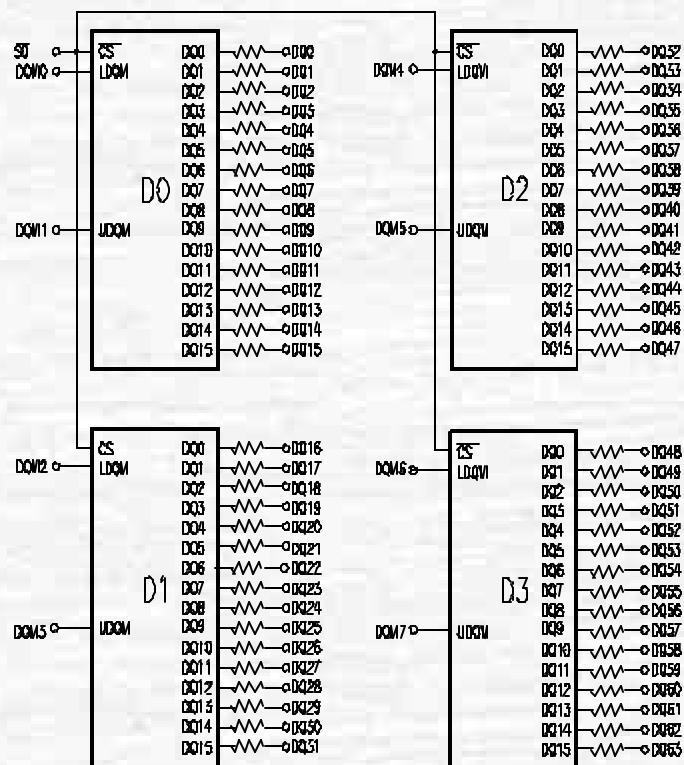


## Package Dimension

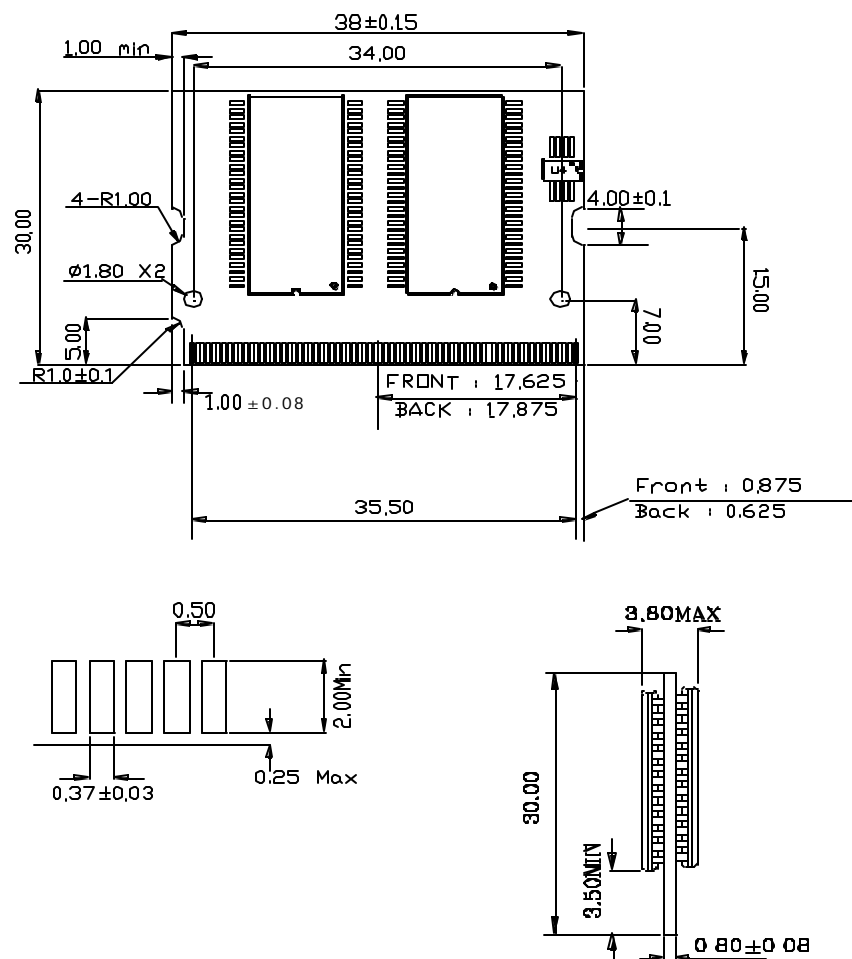


# SDR Micro SODIMM

## Block Diagram



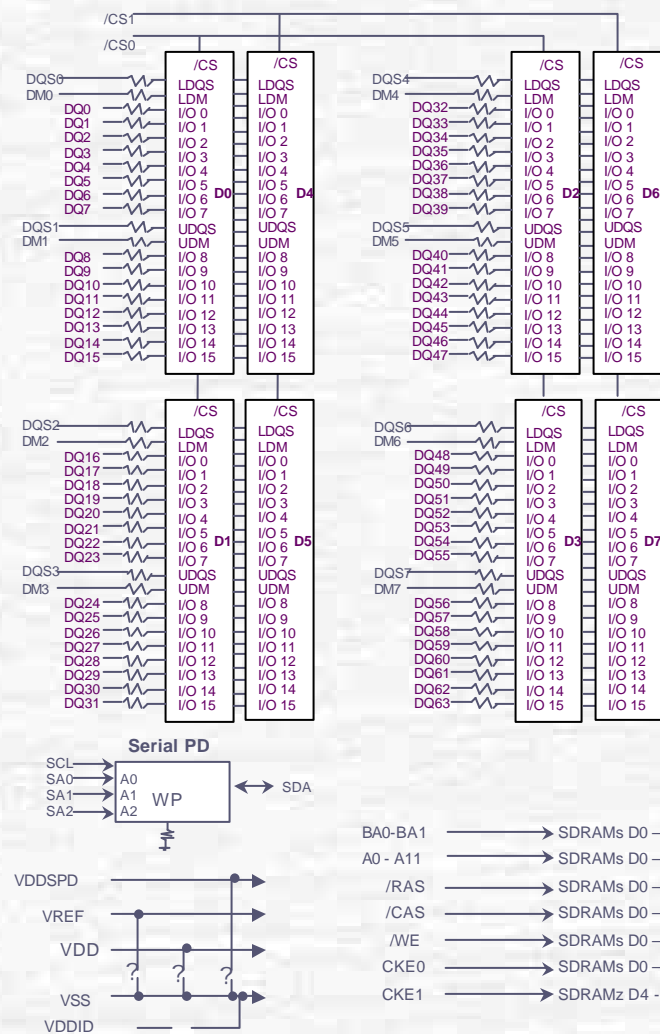
## Package Dimension



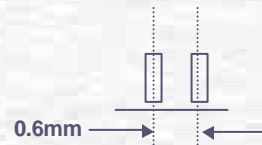
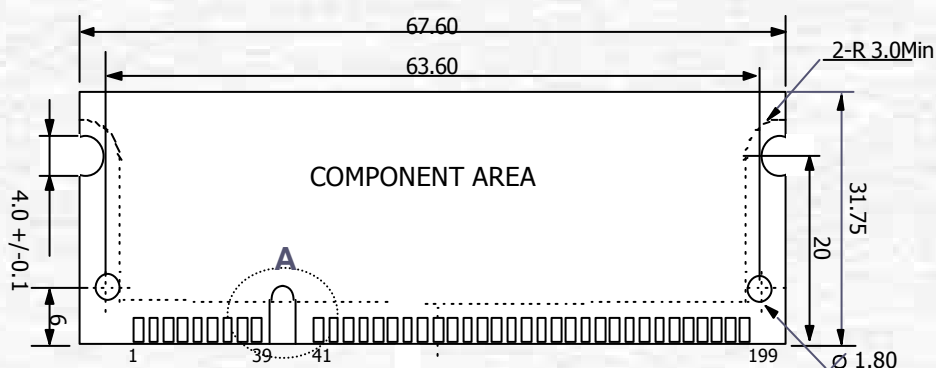


# DDR SODIMM

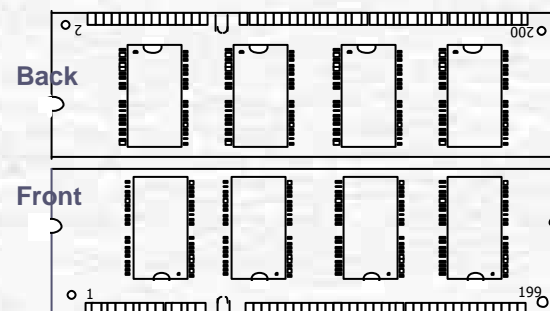
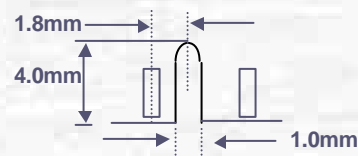
## Block Diagram



## Package Dimension



## Detailed A



# 200Pin DDR SO-DIMM Gerber Status

R/C #	Description	Module Banks	Common Gerber	Status	Module Density	Availability
R/C A	x16, x64	2	A 0.5	C/S	128MB	Now
R/C B	x8, x64	1	B 0.5	C/S	128MB	Now
R/C C	x16, x72 ECC	1	C 0.5	C/S	64MB	Now

# Hyundai DDR SO-DIMM

<u>HYUNDAI</u>	Organization	Component Composition	Clock Frequency	PCB Height	SS/DS	CL	Availability
DDR SO DIMM 512MB	64Mx64	(2*32Mx16)*4	100/133MHz	1.25"	DD	2, 2.5	December
DDR SO DIMM 512MB	64Mx64	(64Mx8)*8	100/133MHz	1.25"	DD	2, 2.5	December
DDR SO DIMM 256MB	32Mx64	(32Mx16)*4	100/133MHz	1.25"	SS	2, 2.5	December
DDR SO DIMM 256MB	32Mx64	(2*16Mx16)*4	100/133MHz	1.25"	DD	2, 2.5	May
DDR SO DIMM 256MB	32Mx64	(32Mx8)*8	100/133MHz	1.25"	DD	2, 2.5	May
DDR SO DIMM 128MB	16Mx64	(16Mx16)*4	100/133MHz	1.25"	SS	2, 2.5	May
DDR SO DIMM 128MB	16Mx64	(2*8Mx16)*4	100/133MHz	1.25"	DD	2, 2.5	Now
DDR SO DIMM 128MB	16Mx64	(16Mx8)*8	100/133MHz	1.25"	DD	2, 2.5	Now
DDR SO DIMM 64MB	8Mx64	(8Mx16)*4	100/133MHz	1.25"	SS	2, 2.5	Now

# Summary

- ✓ **DDR can reduce average power consumption by 35%**
- ✓ **Hyundai is committed to support DDR for all mobile applications**
- ✓ **Hyundai would like to partner with our customers for all design wins**